KVS RO BPL (CLASS XII CBT-PHYSICS OCTOBER 2023-24)

QUESTION PAPER FOR CLSASS XII CBT OCTOBER 2023- 24

CLASS :- XII

SUBJECT :- PHYSICS

TOPIC :- Light - Reflection and Refraction, Optical interference - Light as a Wave

Read the following paragraph and answer the questions that follows:

The photograph in Figure 1(a) shows an example of light waves traveling in approximately straight lines. A narrow beam of light (the incident beam), angled downward from the left and traveling through air, encounters a plane (flat) water surface. Part of the light is reflected by the surface, forming a beam directed upward toward the right, traveling as if the original beam had bounced from the surface. The rest of the light travels through the surface and into the water, forming a beam directed downward to the right. Because light can travel through it, the water is said to be transparent; that is, we can see through it. The travel of light through a surface (or interface) that separates two media is called refraction, and the light is said to be refracted. Unless an incident beam of light is perpendicular to the surface, refraction changes the light's direction of travel. For this reason, the beam is said to be "bent" by the refraction. In Figure 1(a) the bending occurs only at the surface; within the water, the light travels in a straight line. In Figure 1(b), the beams of light in the photograph are represented with an incident ray, a reflected ray, and a refracted ray (and wavefronts). Each ray is oriented with respect to a line, called the normal, that is perpendicular to the surface at the point of reflection and refraction. In Figure 1(b) the angle of incidence is ϴ1, the angle of reflection is ϴ'1 , and the angle of refraction is ϴ2, all measured relative to the normal. The plane containing the incident ray and the normal is the plane of incidence, which is in the plane of the page in Figure1(b). Experiment shows that reflection and refraction are governed by two laws: Law of reflection: A reflected ray lies in the plane of incidence and has an angle of reflection equal to the angle of incidence (both relative to the normal). That is ϴ1 = ϴ'1 Law of refraction: A refracted ray lies in the plane of incidence and has an angle of refraction ϴ2 that is related to the angle of incidence ϴ1 by n2 sin ϴ2 = n1 sin ϴ1 . Here each of the symbols n1 and n2 is a dimensionless constant, called the index of refraction, that is associated with a medium involved in the refraction. This equation is called Snell's law. The index of refraction of a medium is equal to c/v, where v is the speed of light in that medium and c is its speed in vacuum. For vacuum, n is defined to be exactly 1; for air, n is very close to 1.0 (an approximation). Nothing has an index of refraction below 1.

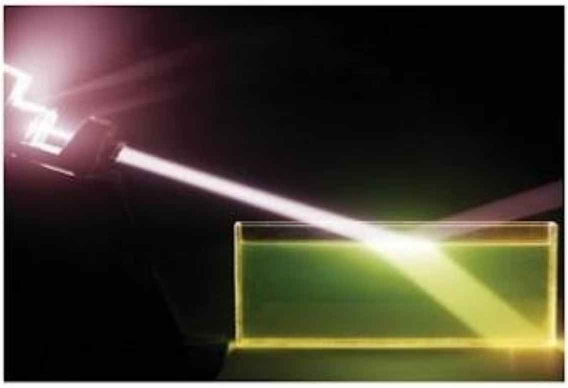

Figure 1a

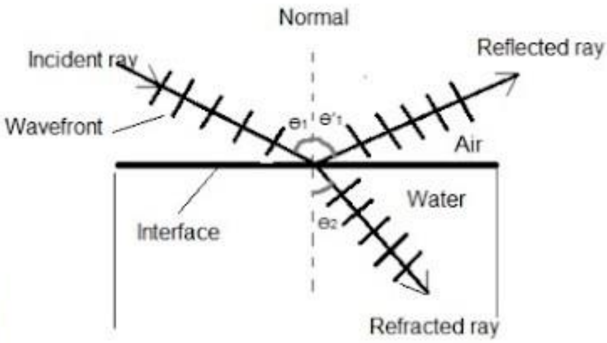

Figure 1b

1. If the light moving in a straight line bends by a small but fixed angle, it may be a case of

(a) reflection only

(b) refraction only

(c) reflection or refraction

(d) diffraction

Ans - b

Feedback - it is a case of refraction as light bends by small angle.

2. Refraction changes the light's direction of travel *

(a) at the surface always

(b) within the medium

(c) at the surface if incident beam of light is not perpendicular to the surface

(d) both at the surface and within the medium

Ans - c

Feedback - light travel straight (no refraction) when it is incident perpendicular to surface.

3. Total internal reflection can take place only if *

(a) Light goes from optically rarer medium to optically denser medium

(b) Light goes from optically denser medium to optically rarer medium

(c) The refractive indices of the two media are close to each other

(d) The refractive indices of the two media are widely different.

Ans - b

Feedback - it is the condition of TIR

4. A ray of light travelling in water is incident on its surface open to air. The angle of incidence is Θ, which is less than the critical angle. Then there will be *

(a) Only a reflected ray and no refracted ray.

(b) Only a refracted ray and no reflected ray.

(c) A reflected ray and a refracted ray and the angle between them would be less than π - Ө.

(d) A reflected ray and a refracted ray and the angle between them would be greater than π - Ө

Ans - b

Feedback - refraction takes place when angle of incidence is greater then critical angle.

5. Assertion-Reasoning Question: *

Assertion: The formula connecting u, v and f for a spherical mirror is valid only for mirrors whose sizes are very small in compared to their radii of curvature.

Reason: Laws of reflection are strictly valid for plane surface, but not for large spherical surfaces.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false and R is also false.

Ans - c

Feedback - laws of reflection is valid for spherical surface also.

CASE STUDY - 2

Optical interference - Light as a Wave

Read the following paragraph and answer the questions that follows:

Nature has long used optical interference for coloring. For example, the wings of a Morpho butterfly are a dull, uninspiring brown, as can be seen on the bottom wing surface, but the brown is hidden on the top surface by an arresting blue due to the interference of light reflecting from that surface (Figure 2a).

Moreover, the top surface is color-shifting; if you change your perspective or if the wing moves, the tint of the color changes. Similar color shifting is used in the inks on many currencies to thwart counterfeiters, whose copy machines can duplicate color from only one perspective and therefore cannot duplicate any shift in color caused by a change in perspective. To understand the basic physics of optical interference, we must largely abandon the simplicity of geometrical optics and return to the wave nature of light. The first convincing wave theory for light was in 1678 by Dutch physicist Christian Huygens. Mathematically simpler than the electromagnetic theory of Maxwell, it nicely explained reflection and refraction in terms of waves and gave physical meaning to the index of refraction. Huygens' wave theory is based on a geometrical construction that allows us to tell where a given wavefront will be at any time in the future if we know its present position. Huygens' principle is: All points on a wavefront serve as point sources of spherical secondary wavelets. After a time t, the new position of the wavefront will be that of a surface tangent to these secondary wavelets. In 1801, Thomas Young experimentally proved that light is a wave, contrary to what most other scientists then thought. He did so by demonstrating that light undergoes interference, as do water waves, sound waves, and waves of all other types. In addition, he was able to measure the average wavelength of sunlight; his value, 570 nm, is impressively close to the modern accepted value of 555 nm. Figure 2b shows a photograph of the interference pattern produced by the arrangement in Young's interference experiment. The photograph is a front view of part of screen. The alternating maxima and minima are called interference fringes because they resemble the decorative fringe sometimes used on clothing and rug

Figure 2a

Figure 2b

6. When a light wave enters a glass slab from air *

- a. its wavelength decreases.
- b. its wavelength increases.
- c. its frequency decreases.
- d. neither its wavelength nor its frequency changes

Ans -a

Feedback - as per law wavelength decreases

7. 7. In Young's double slit experiment, the separation between the slits is halved and the distance between the slits and the screen is doubled. The fringe width is *

- a. unchanged.
- b. halved.
- c. doubled.
- d. quadrupled.

Ans -d

Feedback: fringe width = $\lambda D/d$

Since d is halved and D is doubled so fringewidth increases 4 times.

8. Two sources are called coherent if they produce waves *

- a. of equal wavelength.
- b. of equal velocity.
- c. having same shape of wavefront.
- d. having a constant phase difference.

Ans - d

Feedback : as per definition of coherent source

9. wavefronts of light coming from a distant source of unknown shape are nearly *

- a. plane
- b. elliptical
- c. cylindrical
- d. spherical

Ans - a

Feedback - wavefronts from distant source are plane.

10. **Assertion-Reasoning Question:** *

Assertion: A common example of a virtual image is a pool (a mirage- a type of illusion) of water that appears to lie on the road some distance ahead of you on a sunny day, but that you can never reach.

Reason: A mirage is formed because a light ray, after descending from the lower portion of the sky, once it is horizontal, somewhat above the road's surface, it still bends because the lower portion of each associated wavefront is in slightly warmer air and is moving slightly faster than the upper portion of the wavefront

- (A) Both A and R are true and R is the correct explanation of A.
- (B) Both A and R are true but R is not the correct explanation of A.
- (C) A is true but R is false.
- (D) A is false and R is also false.

Ans -a

Feedback - reason correctly explains the phenomenon.

Answer Key OCTOBER Month CBT Physics XII

Q No	Answer
1	b
2	c
3	b
4	b
5	c
6	a
7	d
8	d
9	a
10	a

Feedback:

1. Average score in this test is 4.89/10
2. Question 3,6, and 9 are scored by most of the students,
3. Question 4 and 7 is scored by least No of students.
4. Median marks scored by students is 5